BUROHAPPOLD ENGINEERING

Northumberland Development Project

Energy Strategy for Planning

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author	**James Davies**
date	**28/08/15**
approved	**Simon Wright**
signature	
date	**28/08/15**

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1 Introduction

This documents sets out the proposed energy strategy for the Northumberland Development Project located in Haringey, North-East London. This document has been prepared in alignment with GLA guidance "Greater London Authority guidance on preparing energy assessments (April 2015)" and other accompanying documentation from both the GLA and Haringey.

1.1 Description of the scheme

The Northumberland Development Project is a major development located in the Borough of Haringey on and surrounding the existing White Hart lane stadium. The development will be constructed in several phases with the Stadium being completed initially, followed by the other buildings at varying stages. A render of the proposed development is shown in Figure 1—1 and comprises of the following components:

- **Stadium (D)** - 61,000 seat capacity with suitability for 55,000 capacity music concert use
- **Hotel (D)** - 180 bed hotel with 49 serviced apartments
- **Tottenham Experience (D)** - Museum, megastore and other assorted uses
- **Residential Towers (O)** - 585 dwellings and business community uses at plinth level
- **Extreme Sports (O)** - Sports/activity centre
- **North-East building (O)** - Community health centre

The application is a hybrid application seeking part outline and part detailed planning permission (indicated above O=Outline, D= Detailed). The varying levels of detail submitted for approval are referenced throughout the document, as this has an impact on the level of detail and analysis present in this document.

Figure 1—1 Proposed development

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1.2 Policy and Drivers

1.2.1 Building Regulations Part L 2013

Part L of the 2013 Building Regulations refers to the Conservation of Fuel and Power in both new construction dwellings (Part L1A) and non-domestic buildings (Part L2A). These documents stipulates a minimum level of efficiency that buildings must be constructed to. The guide to the regulations (Approved Documents) must be read in conjunction with other supporting documents, such as the National Calculation Methodology (NCM) Modelling Guide 2013.

Compliance with these regulations in demonstrated through thermal modelling analysis. For domestic buildings this is demonstrated through SAP (Standard Assessment Procedure calculations) and for non-domestic buildings dynamic simulation energy modelling or SBEM (Simplified Building Energy Model) is required.

1.2.2 London Plan

The London Plan is a policy planning framework for the Greater London Area, within which Haringey is located. This document is intended as an overarching policy to inform all of the London Boroughs and facilitate achievement of the ambitious climate change targets. By definition the document has been incorporated within London Borough of Haringey's policies. For clarity the key energy related requirements are outlined below.

Energy	5.2 Minimising CO2 Emissions	Developments should achieve a carbon emission improvement of 35% on Part L 2013 Building Regulations, or as per Building Regulations requirements after 2016
	5.3 Sustainable Design and Construction	Developments must demonstrate that sustainable design standards are integral to the proposal and is applicable to the design, construction and operation stage of this project. Further guidance in the Mayor's Supplementary Planning Guidance (SPG)
	5.6 Decentralised Energy in Development Proposal	Development should evaluate the feasibility of decentralised energy networks including Combined Heat and Power (CHP) systems
	5.7 Renewable Energy	Seek to reduce emissions in line with Policy 5.2 via use of onsite renewable energy options. There is a presumption that all major development proposals will seek to reduce carbon emissions by at least 20% through renewable energy where feasible
	5.9 Overheating and Cooling	Developments should demonstrate how the proposal will seek to minimise potential overheating and reliance on air conditioning systems

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1.2.3 London Borough of Haringey

In addition to the overarching policies of the London Plan, Haringey has several strategic policies included within its Local Plan, and further elaborated upon within the Supplementary Planning Guidance documents. The most relevant energy-related policy is 'SP4: Working towards a low carbon Haringey'.

This sets out requirements for all developments to assess the viability of connecting to existing heating and cooling networks, provision of site wide CHP, and communal heating and cooling systems. This is in line the GLA London Plan expectations and should follow the same energy hierarchy. The Local Plan also specifies a 20% reduction in carbon emissions from onsite renewable energy regeneration, which can include connections to local sources of decentralised renewable energy.

As previously stated, unless local policies are more stringent, the London Plan requirements should take precedence in defining the most onerous targets for the development.

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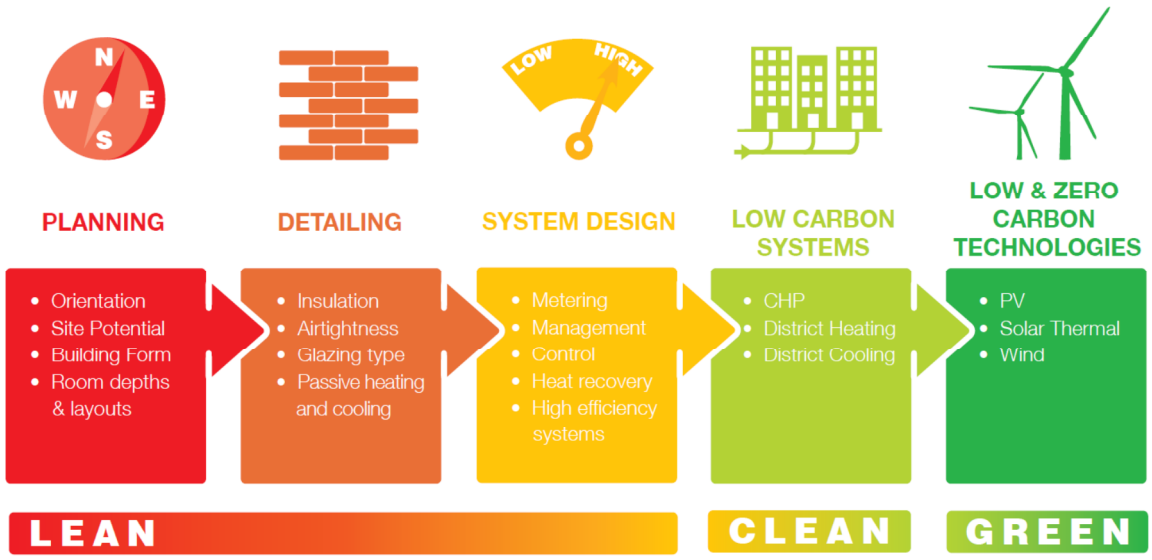
2 Approach

2.1 Strategy

In accordance with planning policy, the energy strategy for the development has been developed in alignment with the energy hierarchy; Lean, Clean, Green.

This approach aims to minimise energy consumption from the outset through the use of efficient massing, passive measures and efficient systems before the deployment of low and zero carbon technologies.

- Lean: Maximise energy efficiency
- Clean: Supply energy efficiently using low carbon heating and cooling systems
- Green: Incorporate renewable energy



2.2 Energy modelling methodology

As stipulated by planning policy guidance, all Carbon Dioxide emissions of the proposed development must be reported on. In order to provide this information, energy modelling has been performed on the entire development and the results are presented throughout this report. Two different methodologies have been utilised to assess the non-domestic and domestic elements of the scheme, in order to produce the required outputs for reporting purposes. These have been used to estimate the baseline CO_2 emissions values as well as the Carbon Dioxide emissions dioxide reductions achieved from application of the Lean, Clean, Green hierarchy.

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The Table 2—1 below summarises the utilised methodologies.

Table 2—1 Modelling methodologies

Typology	Methodology (software)	Required for
New build – Domestic	SAP (STROMA)	Building regulations/Planning Policy
New build – Non-domestic	Dynamic simulation model (IES)	Building regulations/BREEAM/Planning Policy

Carbon Dioxide emissions reductions achieved through the design proposals have been detailed for each of the different building typologies within the development, as well as collectively to demonstrate the whole development performance.

2.2.1 Unregulated energy

The energy modelling methods outlined above refer to the regulated energy demands within the development i.e. space heating, domestic hot water, fixed lighting, fans and pumps. Planning policy requires that reporting on unregulated energy demand is also required for the development.

Energy modelling of non-domestic typologies (utilising NCM methodology) provides an estimate of unregulated Carbon Dioxide emissions in the form of 'Equipment' loads. For domestic units the BREDEM (Building Research Establishment Domestic Energy Model) methodology has been adopted.

2.3 Detailed & Outline Planning Permission

The planning application is a hybrid application that seeks part detailed and part outline planning permission. Based on this level of approval sought, the level of detail for each building is very varied and has been reflected through the CO2 emissions analysis performed. Strategies have been explored for the site as a whole and are explained within the body of the report, but the detailed assessments of each individual building are reflective of this varied level of design.

A summary of the approach used has been presented below:

Permission Sought	Level of Design	CO2 emissions assessment
Detailed	Complete architectural plans, sections and elevations Concept MEP strategies	Full Part L modelling analysis
Outline	Basic form (excluding facades details) Basic programme of use typologies	Non-domestic - Estimate of CO2 emissions based on industry benchmarks or similar projects Domestic – Estimate of CO2 emissions based on indicative apartment layout modelling

Information presented for buildings seeking outline permission will be refined at the subsequent reserved matters application stage through the use of full dynamic thermal modelling. At this stage an estimate has been produced to reflect the potential carbon emissions impacts from the development as a whole.

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3 Site-wide systems

In order to deliver the greatest savings in Carbon Dioxide emissions possible, the feasibility of site-wide systems suitable for the development have been explored below.

3.1 Decentralised energy networks

London Borough of Haringey and the Greater London Authority strongly promote the implementation of decentralised energy networks (DENs) across London. In alignment with planning policy, the feasibility of a DEN within the context of the development has been assessed through the following hierarchy:

1. Connection to existing/proposed networks
2. Development of a DEN
3. Site-wide network

3.1.1 Planned Haringey DEN

With any new development, the potential to connect into an existing or proposed DEN can provide significant benefits for the reduction of Carbon Dioxide emissions for the development itself and the wider network. Exploring connection into a planned network can increase the viability of the network itself by creating additional demand and future revenues.

At present there are no existing DENs located in the vicinity of the development. However, the area has been identified as a key development area within the Haringey Sustainable Design and Construction SPG[1]. The identified area can be seen as Zone 1 in Figure 3—1 largely driven by the proposals for the regeneration of the Northumberland Park area [2].

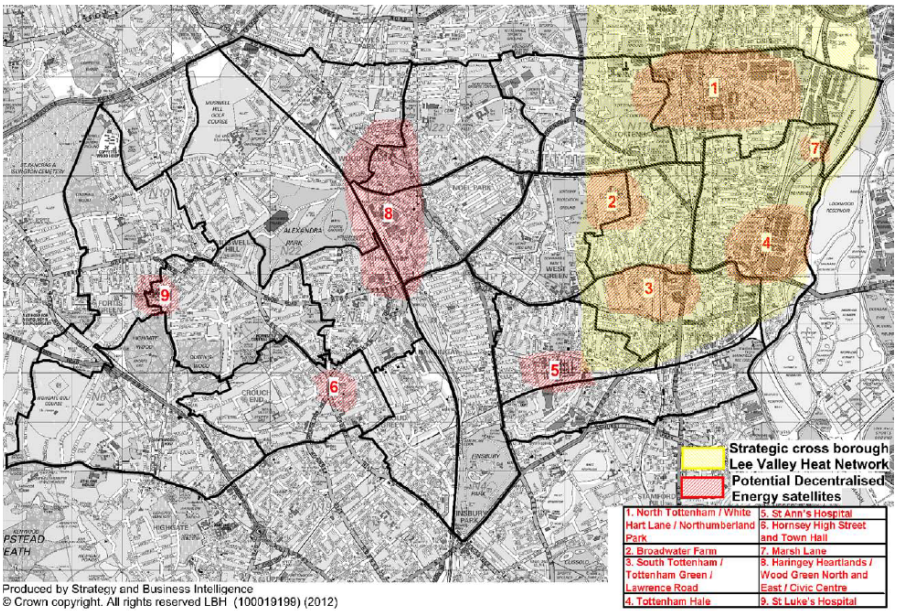

Figure 3—1 Potential for decentralised energy in Haringey (Local Plan: Sustainable Design and Construction SPG Appendices Pg 8)

[1] http://www.haringey.gov.uk/housing-and-planning/planning/planning-policy/local-development-framework-ldf/supplementary-planning-guidance-documents/sustainable-design-and-construction-spd
[2] http://www.haringey.gov.uk/housing-and-planning/tottenham/tottenham-regeneration/northumberland-park-area-and-regeneration#Next%20steps

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The Council is committed to delivering a district energy solution in this part of Tottenham, most likely a district heating network supplied by gas-fired CHP engines, as part of its wider regeneration plans for the redevelopment of the High Road West and Northumberland Park estates on either side of the NDP site. It is envisaged that these sites will deliver in the order of 7,000 new homes over the next 20 years and that these homes will be served by a DEN. The Council has instructed Parsons Brinkerhoff to prepare a techno-economic viability report for the installation of a DEN in close proximity to the NDP site and a report is expected to be completed by the end of the year.

Plans for development of a DEN within the vicinity of the development are seen as a major opportunity for the Northumberland Development Project, and conversely it is a key part of the district heating feasibility as it is likely to be the first phase of the regeneration proposals. It is proposed that all buildings will be designed to connect into this network when completed. Timelines for the completion of the DEN are still to be confirmed, but there is clear commitment from the Council for a DEN to be delivered at the earliest opportunity.

The Club is committed to working with the Council to advance an energy strategy and assess the feasibility of a DEN and its location within the surrounding regeneration areas, and indeed there is already cooperative working between the parties on this matter.

3.1.2 Proposed strategy

The energy strategy that supports this application is premised on connecting the development in to the DEN once it is delivered. Timeframes for delivery of the network have not yet been confirmed, but it is generally considered that it will come online after completion of the first phase (including the stadium) but hopefully before future phases of the project are complete.

Based on this assumption the proposals for connection and integration with the DEN are as follows:

- Phase 1 complete (Stadium, Tottenham Experience, NE Building)
    - DEN not operational
    - Gas fired boiler plant located in the Stadium's East-Stand will supply all heating demands of the Stadium, Tottenham Experience and NE Building via a site-wide heating network.
    - Systems designed to be district-ready, suitable for future DEN connection.
- Future phases complete (Hotel, Extreme sports, residential towers)
    - DEN operational
    - Connection to the Haringey District Heating network installed to supply heat to all building within the NDP.
    - Connection arrangements (location of entry point, internal routing of pipework, ownership, maintenance requirements etc.) to be agreed. These technical requirements are being developed in consultation with the Haringey DEN team to develop the most appropriate solution for all parties.

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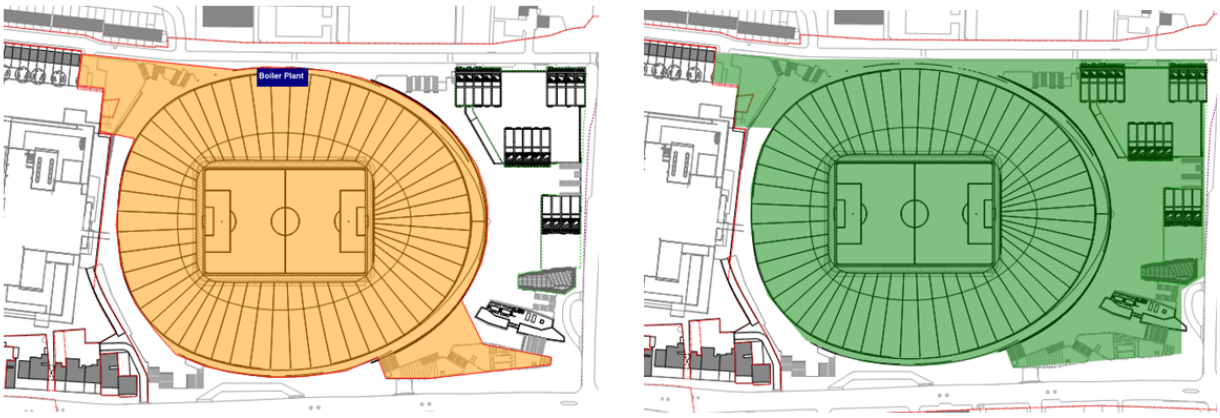

Figure 3—2 Left: Phase 1 site-wide network supplied by gas boilers. Right: Whole-site to be supplied from Haringey District Heating (connection point and internal distribution to be worked up with Haringey).

In the unfortunate scenario that a Haringey district heating network is not constructed, the energy strategy proposals above will be revisited. A similar strategy to the Phase 1 proposals will be pursued, installing building level heating plant which is futureproofed for any future developments in the district heating network proposals. The feasibility for low-carbon heating systems (e.g. CHP) for each building will also be explored as a strategy to provide further Carbon Dioxide emissions savings which would otherwise have been achieved through the DEN connection..

3.1.3 Modelling approach

Due to the level of technical information available at this time, Carbon Dioxide emissions reductions available through connection to a district heating network cannot be quantified in detail. For the purposes of this report, an estimate of the reductions available have been made using assumptions aligned with the Notional Building, (carbon factor 0.15 kgCO2/kWh heat) but will be refined once technical information is available regarding the proposed network.

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3.2 Low and zero carbon (LZC) technology

LZC technology can help to deliver significant Carbon Dioxide emissions reductions arising from developments. The table below summarises the potential of various LZC technologies considering the context of the proposed development.

Technology	Comments	Viability
Wind turbine	• Generates electricity • Development is located in a high density urban environment. Wind flows in such locations are often turbulent which significantly reduce the available energy output • No land area for installation of a turbine. Roof mounted vertical axis systems do not offer an efficient method of generation.	**LOW**
Biomass	• Generates heat/hot water • Development's location in central London creates difficulties for frequent fuel deliveries and air quality • Poor compatibility with proposed District Heating connection from wider network	**LOW**
Air source heat pump	• Generates heat/hot water (pre-heat) • Typically used as an alternative to gas-fired boilers to meet space heating requirements. Very low resultant CO2 savings. • Potential noise issues and visual impact • Poor compatibility with proposed District Heating connection from wider network	**LOW**
Ground source heat pump	• Generates heat/hot water (pre-heat) • Requires close coupling to building piles, a significant number of expensive and deep boreholes or a large shallow area in which a 'slinky' can be laid • Very constrained development site – coupling with building piles is only possible solution (very high cost). • Poor compatibility with proposed District Heating connection from wider network	**LOW**
Solar thermal	• Generates heat/hot water • Low maintenance, efficient technology • Moderate Carbon Dioxide emissions savings due to displacement of natural gas instead of Carbon Dioxide emissions intensive grid electricity • Most suitable for hotel and residential application, with very limited roof area however. • Poor compatibility with proposed District Heating connection from wider network	**MEDIUM**

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Solar Photovoltaics (PV)	• Generates electricity • Some very small roof areas across the development potentially available • Simple installation, low maintenance • Good delivered Carbon Dioxide emissions savings for the development compared to Carbon Dioxide emissions intensive national grid supply	 **MEDIUM**

As demonstrated above, LZC options for the development are limited to Solar Technologies. Due to the proposed district heating connection, it is considered that the limited roof area available would be more beneficial for Solar Photovoltaics from a Carbon Dioxide emissions reduction perspective as heat-based savings will be delivered from the network connection.

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3.2.1 Solar PV

Although Solar Photovoltaics have been identified as the most suitable LZC technology for the site, their application is highly limited due to the form and context of the development. A summary of the proposals across the development is shown below.

Building	Details	Proposal
Stadium	Lightweight structural solution proposed for the stadium roof design. Roof loading is not designed to accommodate Solar PV loading (20kg/m2). Additional capital cost for a structural solution which could accommodate Solar PV, is not considered viable in addition to the cost of the panels.	No Solar PV proposed
Hotel	Unobstructed roof area due to high-rise form Significant amount of roof top MEP plant – Ventilation plant, lift plant, chillers, water storage. External restaurant/bar areas also proposed.	No Solar PV proposed
Tottenham Experience	Low level building where all Westerly sun is blocked by Hotel tower significantly reducing Solar PV output. Large proportion of roof accessible for roof garden area, with green roof planned for other areas.	No Solar PV proposed
Extreme Sports	Roof area at low-level, overshadowed by surrounding buildings. Potential for a very small array on the highest roof area	No Solar PV currently proposed – to be confirmed at detailed planning
Residential Towers	Unobstructed roof areas suitable for Solar PV. Limited roof area in relation to GFA due to high-rise form. Provisional array proposed, based on estimate of 60% of roof area suitable for PV accounting for roof level plant and spacing between panels for access/maintenance/shading.	**250m2 of Solar PV proposed** – to be confirmed at detailed planning
North-East Building	Low level building located due north of the stadium, therefore roof area significantly shaded.	No Solar PV proposed

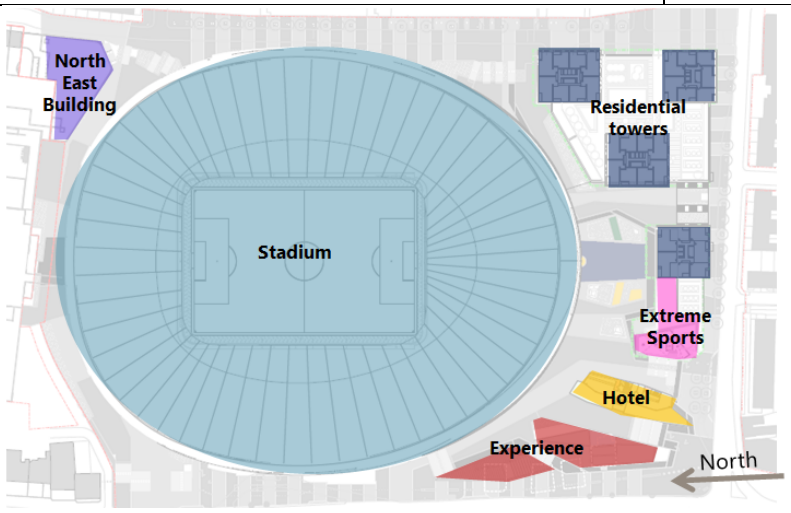

Figure 3—3 Site plan

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4 Detailed application

The following section presents the Carbon Dioxide Emissions results following thermal modelling assessment of the development components seeking detailed planning approval.

4.1 Stadium

The stadium represents the major component of the proposed development. The 61,000 seat capacity stadium includes hospitality areas, changing rooms, match-day support facilities, office space and catering facilities. There is additionally a large proportion of un-conditioned spaces such as concourses, car parking and the stadium bowl itself which fall outside of the remit for the Part L modelling.

It should be noted, that from a construction point of view the Tottenham Experience is considered to be the same building as the stadium and shares some common MEP systems (Gas boilers, Chillers, power supply etc.). Due to differing design challenges between the two buildings however, they have been modelled and reported on individually.

4.1.1 Lean

A highly efficient approach to building fabric and MEP systems has been utilised to reduce Carbon Dioxide emissions from the outset. Highly insulted and air-tight fabric has been utilised to reduce heat losses in winter, and minimise solar gains during the summer months.

Fabric element	Unit	Proposed - Stadium	Notional building Part L 2013
External walls	$W/m^2.K$	0.15	0.26
Glazing (incl. frame)	$W/m^2.K$	1.4	1.6
Glazing G-value	-	0.3	0.4
Roof	$W/m^2.K$	0.11	0.18
Floor	$W/m^2.K$	0.11	0.22
Airtightness	m^3/m^2 @50Pa	3	3

The stadium uses a wide range of MEP systems suited to the proposed use of the different areas. All heating is provided by high efficiency gas-fired boilers, with cooling provided through high efficiency air-cooled chillers, or VRF units. Chillers are prioritised for match day operation to maximise their efficiency, therefore self-contained VRF systems are utilised for more frequent daily use facilities (e.g., office areas). All domestic hot water (DHW) is provided centrally with highly insulated pipework to prevent un-necessary heat loss within the building. LED lighting will be used throughout the development to minimise energy consumption of artificial lighting and cooling systems by reducing internal heat gains.

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A summary of the MEP proposals is shown below:

System	Specification
Heating plant	Gas boilers – 95% seasonal efficiency
Cooling plant	Air-cooled chillers – SEER 4.72 VRF – SEER 5-5.2
Ventilation systems	AHU SFP – 0.8-1.55 W/l/s
Lighting efficiency (luminaire)	80 Lumens/Watt
Lighting controls	PIRs and daylight controls where appropriate

Following application of these measures the Stadium achieves a 4%reduction below the Part L 2013 Notional Building. Results for the stadium broken down by energy use are shown below.

$kgCO_2/m^2.yr$	**Actual**	**Notional**
Heating	4.0	5.0
DHW	9.8	8.8
Cooling	6.4	5.6
Aux	8.8	10.2
Lighting	8.3	9.3
Total	**37.2**	**38.9**
	4% Reduction	

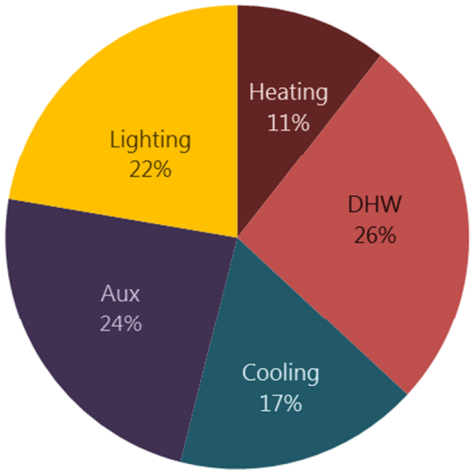

Figure 4—1 Actual building breakdown

4.1.2 Clean

As discussed previously, it is proposed that the Stadium will connect into the proposed Haringey District Heating network. Although technical information regarding the network performance is not yet available based on a network performance aligned with the Notional Building it is estimated that a Carbon Dioxide emissions reduction of 15% could be achieved compared to a Part L 2013 gas-fired boiler TER.

4.1.3 Green

No renewables are proposed for the Stadium development as outlined in Section 4.

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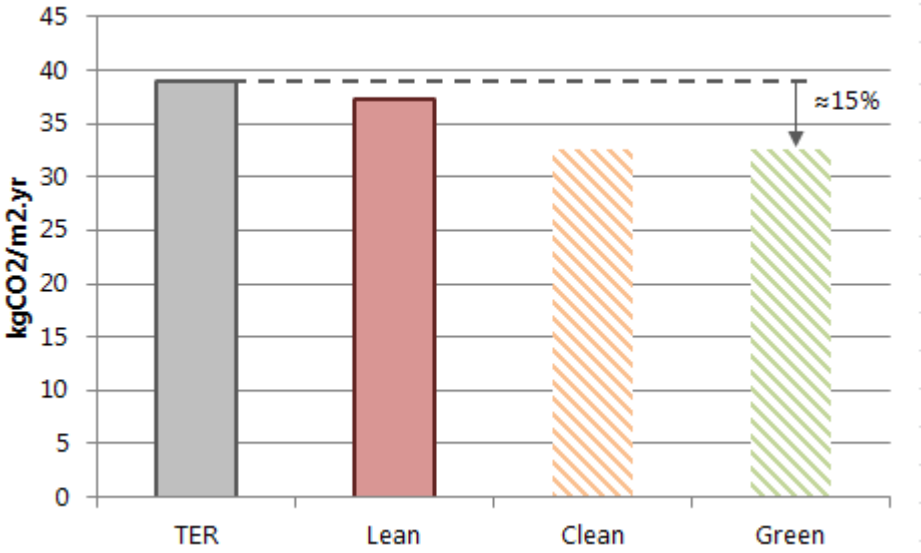
4.1.4 Results

Following the application of the energy hierarchy, it is estimated that the Stadium can achieve Carbon Dioxide emissions reduction of 4% without a connection to the district heating network, and potentially 15% with a connection. The impact of a district heating connection will be confirmed when technical details of the network performance are available.



Unit	TER	Lean	Clean	Green
$kgCO_2/m^2.yr$	38.9	37.2	*32.5*	*32.5*
tonnes CO_2/yr	2,088	1,997	*1,746*	*1,746*
%age reduction		4%	*15%*	*15%*

4.1.5 Unregulated

The unregulated Carbon Dioxide emissions as reported by the 'Equipment' load within the Part L BRUKL documentation are indicated below. Measures to reduce unregulated energy consumption form the building will include high efficiency office/IT equipment, low-energy floodlighting, efficient F&B equipment etc.

Building	$kgCO_2/m^2.yr$	tonnes CO_2/yr
Stadium	37.3	1,999

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4.2 Hotel

The hotel building provides a combination of traditional hotel rooms and serviced apartments. It also includes additional facilities such as restaurants, bars, swimming pool and a health club.

4.2.1 Lean

A highly efficient approach to building fabric and MEP systems has been utilised to reduce Carbon Dioxide emissions from the outset. Highly insulted and air-tight fabric has been utilised to reduce heat losses in winter, and minimise solar gains during the summer months. A curtain walling façade system is proposed across the whole building, with an external shading structure providing solar gain mitigation to the majority of spaces within the building.

Fabric element	Unit	Proposed – Hotel	Notional building Part L 2013
Opaque module (curtain walling)	$W/m^2.K$	0.8	0.26
Glazing (incl. frame)	$W/m^2.K$	1.4	1.6
Glazing G-value*	-	0.2-0.3	0.4
Roof	$W/m^2.K$	0.15	0.18
Floor	$W/m^2.K$	0.11	0.22
Airtightness	m^3/m^2 @50Pa	3	3

* Effective g-value created by the external shading structure has been accounted for as an effective g-value.

The hotel is predominantly serviced by fan coil units located in all bedrooms/apartments, with communal areas utilising a similar strategy a simple back ground heating and ventilation provided in the BOH areas. All heating is provided by high efficiency gas-fired boilers, with cooling provided through high efficiency air-cooled chillers.

All domestic hot water (DHW) is provided centrally with highly insulated pipework to prevent un-necessary heat loss within the building. LED lighting will be used throughout the development to minimise energy consumption of artificial lighting and cooling systems by reducing internal heat gains. Intelligent control of lighting and ventilation is proposed within the hotel rooms and apartments via use of the guest room cards.

A summary of the MEP proposals is shown below:

System	Specification
Heating plant	Gas boilers – 95% seasonal efficiency
Cooling plant	Air-cooled chillers – SEER 4.1
Ventilation systems	AHU SFP – 1.5-1.9 W/l/s
Lighting efficiency (luminaire)	75 Lumens/Watt
Lighting controls	PIRs and daylight controls where appropriate

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Following application of these measures the Hotel achieves a 2%reduction below the Part L 2013 Notional Building. Results for the hotel broken down by energy use are shown below. Majority of savings are achieved through highly efficiency lighting systems (including display lighting), and an efficient DHW distribution system due to a single loop configuration to prevent un-necessary pipe lengths. The building energy demand is hot water dominated due to the large number of showers, bathroom, pool facilities, catering laundry, etc.

kgCO2/m2.yr	Actual	Notional
Heating	7.3	5.0
DHW	45.3	45.7
Cooling	2.9	2.9
Aux	13.8	14.2
Lighting	3.9	6.7
Total	73.2	74.4
	2% Reduction	

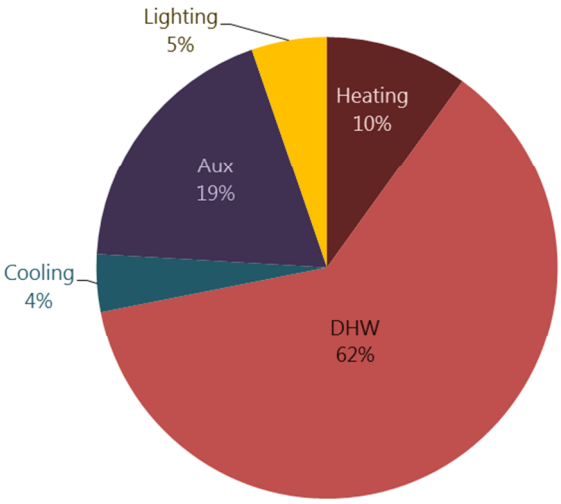

Figure 4—2 Actual building breakdown

4.2.2 Clean

As discussed previously, it is proposed that the Hotel will connect into the proposed Haringey District Heating network. Although technical information regarding the network performance is not yet available based on a network performance aligned with the Notional Building it is estimated that a Carbon Dioxide emissions reduction of 25% could be achieved compared to a Part L 2013 gas-fired boiler TER. The significant potential reduction is due to the major heat-demands associated to the hotel which the district heating would help to minimise.

4.2.3 Green

No renewables are proposed for the Hotel development as outlined in Section 4.

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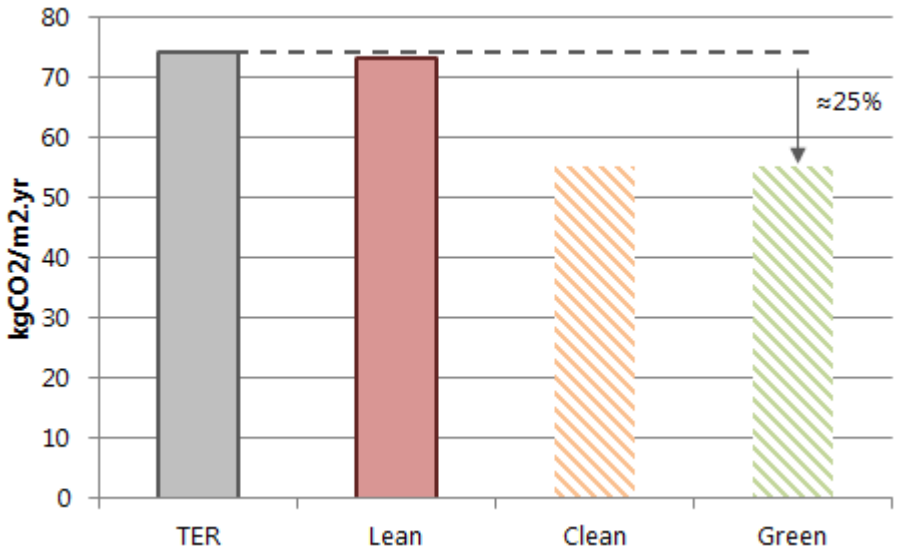
4.2.4 Results

Following the application of the energy hierarchy, it is estimated that the Hotel can achieve Carbon Dioxide emissions reduction of 2% without a connection to the district heating network, and potentially 25% with a connection. The impact of a district heating connection will be confirmed when technical details of the network performance are available.



Unit	TER	Lean	Clean	Green
$kgCO_2/m^2.yr$	74.4	73.2	*55.3*	*55.3*
tonnes CO_2/yr	1,171	1,151	*870*	*870*
%age reduction		2%	*25%*	*25%*

4.2.5 Unregulated

The unregulated Carbon Dioxide emissions as reported by the 'Equipment' load within the Part L BRUKL documentation are indicated below. Measures to reduce unregulated energy consumption from the building will include high efficiency office/IT equipment, low-energy vertical transport systems, efficient catering equipment, pool covers etc.

Building	$kgCO_2/m^2.yr$	tonnes CO_2/yr
Hotel	29.1	456

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4.3 Tottenham Experience

The Tottenham Experience building comprises mainly of the club's megastore, ticket sales facilities, museum/exhibition facilities and a café. It has an accessible roof area for public access and is integrated around Warmington House, a Grade 1 listed building.

4.3.1 Lean

A highly efficient approach to building fabric and MEP systems has been utilised to reduce Carbon Dioxide emissions from the outset. Highly insulted and air-tight fabric has been utilised to reduce heat losses in winter, and minimise solar gains during the summer months. The architectural concept uses glazed façade at the ground level for the retail spaces, with a more opaque construction on the upper level where the museum exhibits are located. The glazed entrance is an un-conditioned space and therefore not within the remit of the Part L model.

It is understood that no fabric refurbishment is possible for the Warmington house building (except loft insulation), therefore assumptions have been made regarding its existing fabric performance. It is important to note, that the results are negatively affected by the inclusion of the Warmington house areas as it is comparing an existing listed building to new construction standards. The specific details of how to considered Warmington House from a Building Regulations Part L perspective will need to be discussed with Building Control.

Fabric element	Unit	Proposed – Tottenham Experience	Notional building Part L 2013
External Wall	$W/m^2.K$	0.2	0.26
Glazing (incl. frame)	$W/m^2.K$	1.4	1.6
Glazing G-value	-	0.2-0.3	0.4
Roof	$W/m^2.K$	0.15	0.18
Floor	$W/m^2.K$	0.11	0.22
Warmington House – External Wall	$W/m^2.K$	2.5	0.26 (new construction)
Warmington House - Glazing	$W/m^2.K$	5.6	1.6 (new construction)
Airtightness	m^3/m^2 @50Pa	3	3

The Experience is predominantly serviced by fan coil units supporting a flexible internal layout for retail and exhibition space. All heating is provided by high efficiency gas-fired boilers, with cooling provided through high efficiency air-cooled chillers which are located within the stadium.

All domestic hot water (DHW) is provided centrally with highly insulated pipework to prevent un-necessary heat loss within the building, although hot water demand will be limited. LED lighting will be used throughout the development to minimise energy consumption of artificial lighting and cooling systems by reducing internal heat gains. LED systems will also be used for all display lighting, which comprise a large proportion of energy demand within retail and museum spaces.

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A summary of the MEP proposals is shown below:

System	Specification
Heating plant	Gas boilers – 95% seasonal efficiency
Cooling plant	Air-cooled chillers – SEER 4.72
Ventilation systems	AHU SFP – 1.6 W/l/s
Lighting efficiency (luminaire)	75 Lumens/Watt
Display lighting efficiency (luminaire)	65 Lumens/Watt
Lighting controls	PIRs and daylight controls where appropriate

Following application of these measures the Tottenham Experience achieves a 10%reduction below the Part L 2013 Notional Building. Results for the Tottenham Experience broken down by energy use are shown below. Majority of savings are achieved through high efficiency lighting systems, importantly including display lighting..

kgCO2/m2.yr	Actual	Notional
Heating	5.1	4.1
DHW	10.0	7.9
Cooling	2.6	3.0
Aux	10.7	9.6
Lighting	13.7	22.0
Total	**42.1**	**46.5**
	10% Reduction	

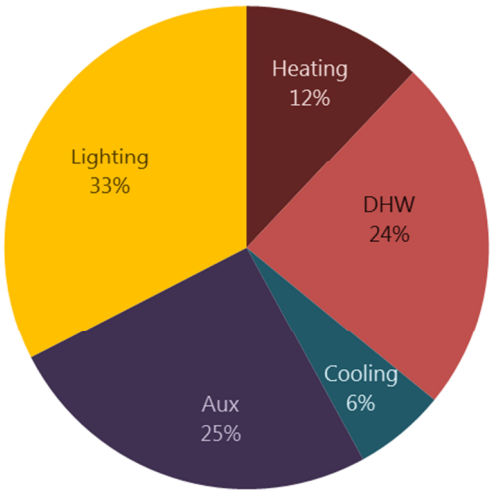

Figure 4—3 Actual building breakdown

4.3.2 Clean

As discussed previously, it is proposed that the Stadium will connect into the proposed Haringey District Heating network, whose heating and cooling distribution will therefore serve the Tottenham Experience building. Although technical information regarding the network performance is not yet available based on a network performance aligned with the Notional Building it is estimated that a Carbon Dioxide emissions reduction of 20% could be achieved compared to a Part L 2013 gas-fired boiler TER.

4.3.3 Green

No renewables are proposed for the Experience development as outlined in Section 4.

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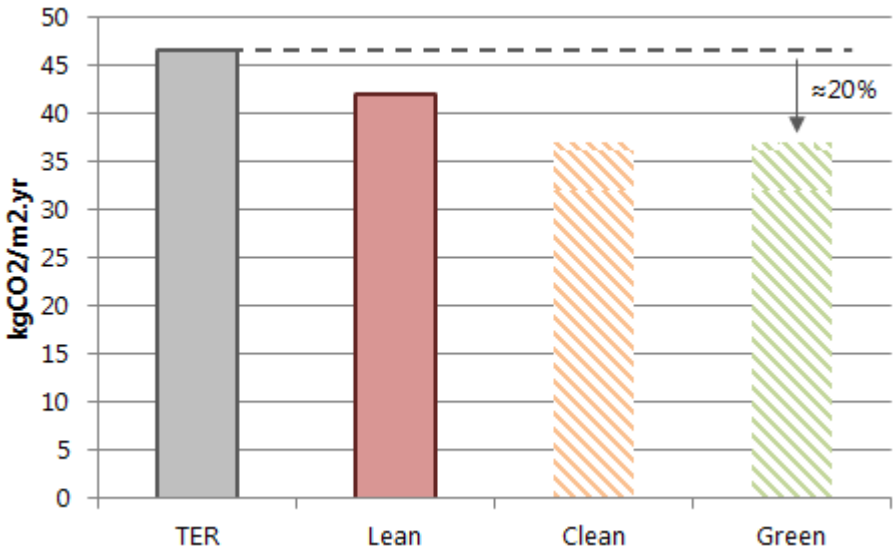
4.3.4 Results

Following the application of the energy hierarchy, it is estimated that the THFX Experience can achieve Carbon Dioxide emissions reduction of 10% without a connection to the district heating network, and potentially 20% with a connection. The impact of a district heating connection will be confirmed when technical details of the network performance are available.



Unit	TER	Lean	Clean	Green
$kgCO_2/m^2.yr$	46.5	42.1	*36.9*	*36.9*
tonnes CO_2/yr	203	183	*161*	*161*
%age reduction		10%	*20%*	*20%*

4.3.5 Unregulated

The unregulated Carbon Dioxide emissions as reported by the 'Equipment' load within the Part L BRUKL documentation are indicated below. Measures to reduce unregulated energy consumption from the building will include high efficiency office equipment, low energy IT equipment, etc.

Building	$kgCO_2/m^2.yr$	tonnes CO_2/yr
THFX Experience	29.1	456

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5 Outline application

The following section presents the Carbon Dioxide Emissions results following thermal modelling assessment of the development components seeking outline planning approval. As explained, limited information is available regarding the precise internal layouts and construction details of these buildings therefore a high-level energy modelling assessment has been carried out. The results presented below will be confirmed within the relevant applications for detailed planning approval.

5.1 Residential

The residential component of the development (585 dwellings) is spread across 4 high-rise towers of varying heights, with 5 town houses located at ground level and some community use also at ground level beneath the podium.

Due to the outline nature of this element of the application, floor plans for the dwellings have not yet been fixed, however an indicative apartment layout has been proposed by the architects (Allies and Morrison). This apartment layout has been used as the basis for this energy assessment, and SAP modelling has been performed using Stroma software.

All information presented below is what will be aspired towards during the detailed development of these buildings. At the moment the information represents a best practice approach for a development of this type, but all information is subject to confirmation and will be communicated in detail within the detailed planning application.

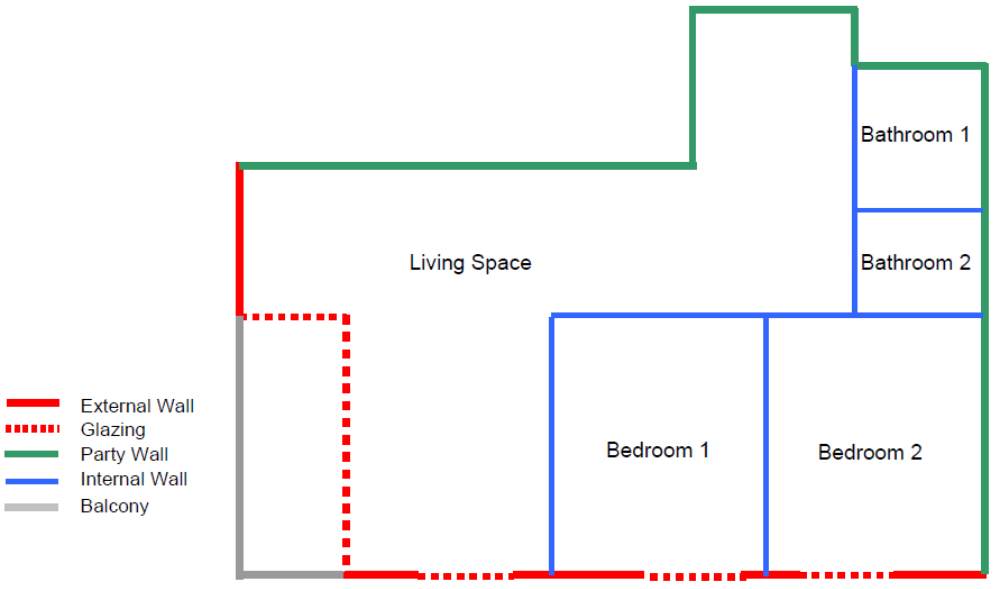

Figure 5—1 Indicative apartment layout

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5.1.1 Lean

In order to minimise energy demand from the outset, a highly efficient building form and fabric performance will be adopted. Fabric performance will include low u-value constructions, and construction details which will minimise the heat loss through thermal bridging.

It is proposed that all dwellings would be ventilated via an MVHR (mechanical ventilation heat recovery) system due to the airtight construction, and overheating risk will be managed through passive measures instead of active cooling systems.

The table below summarises the system parameters used within the modelling of this indicative apartment.

Table 5-1 Building envelope and system parameters

Building Parameter	Value
Roof U-value (W/m^{2}K)	0.10
Wall U-value (W/m^{2}K)	0.15
Glazing U-value (W/m2K) inc. frame	1.40
Glazing g-value	0.68
Opaque door U-value	1.00
Air permeability (m^3/m^2/hour)	3
Ventilation system	MVHR
Heating system	100% gas boiler (community), 89% efficiency
Hot water use	<125 l/p/d
Low energy light fittings	100%

Based on the indicative apartment layout assessed and the inputs proposed above, a lean reduction of 12% could be achieved.

5.1.2 Clean

As discussed previously, it is proposed that the Residential towers will connect into the proposed Haringey District Heating network. Although technical information regarding the network performance is not yet available based on a network performance aligned with best practice (60% CHP supply, 40% gas boiler supply) it is estimated that a Carbon Dioxide emissions reduction of 33% could be achieved compared to a Part L 2013 gas-fired boiler TER.

5.1.3 Green

As indicated in Section 4, it is proposed to explore the potential for a 250m2 Solar PV array across the tower roofs. In order to maximise the benefit form this small roof area it is proposed to use high-performance panels which can achieve efficiencies of 20%.

Apportioning this array across the proposed residential component relative to the GFA of this indicative layout, it is estimated that a Carbon Dioxide emissions reduction of 35% could be achieved compared to a Part L 2013 gas-fired boiler TER.

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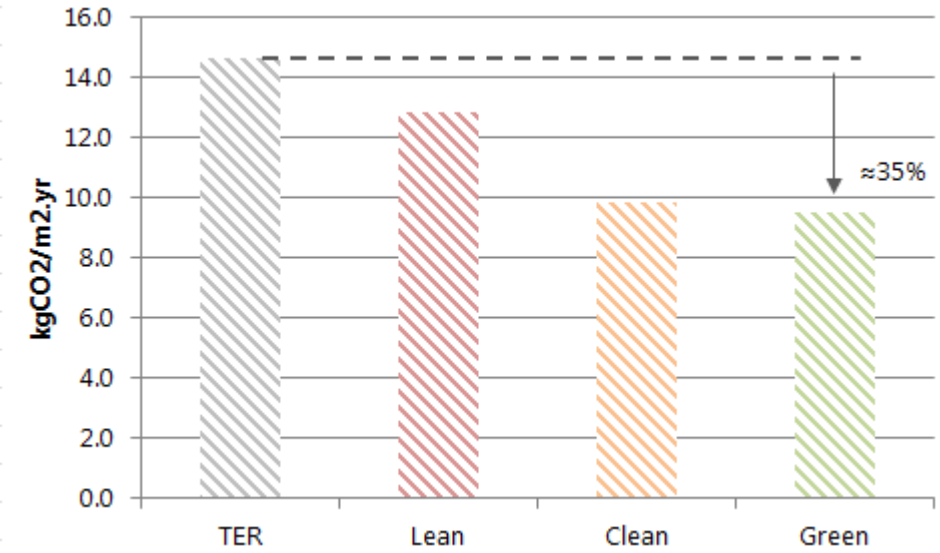
5.1.4 Results

Following the application of the energy hierarchy outlined above, it is estimated that the residential component could achieve a Carbon Dioxide emissions reduction of 15% without a connection to the district heating network (including Solar PV), and potentially 35% with a connection. These results are estimates at this stage, and indicate an order of magnitude for the potential Carbon Dioxide reductions which could be achieved within the development. All details will be explored further and confirmed whet the buildings apply for detailed planning approval. Per m2 values have been summed across the complete residential component floor area below.



Unit	TER	Lean	Clean	Green
$kgCO_2/m^2.yr$	*14.6*	*12.8*	*9.9*	*9.5*
tonnes CO_2/yr	*773*	*678*	*521*	*502*
%age reduction		*12%*	*33%*	*35%*

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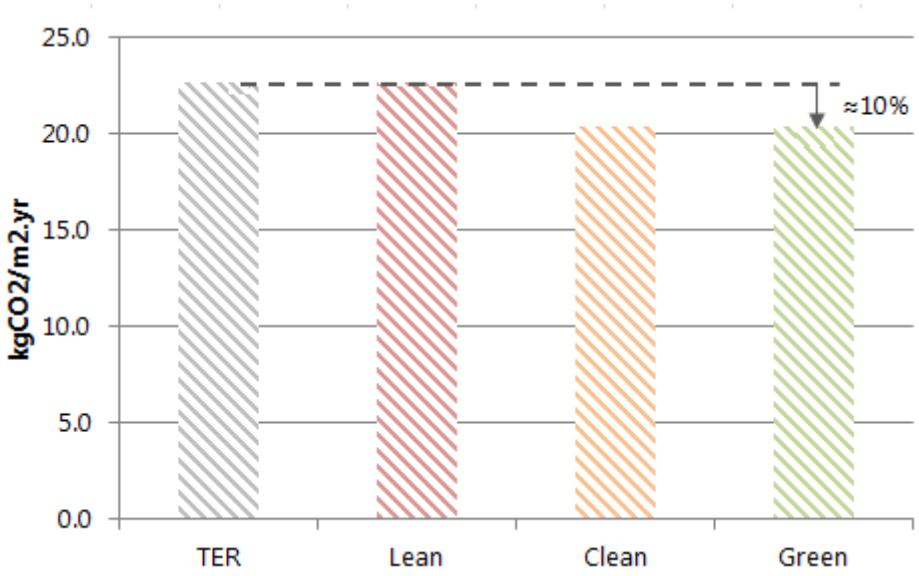
5.2 Extreme Sports Building

The Extreme Sports building is envisaged to include a diving tank, climbing wall among other high-performance sports facilities. At this outline stage façade constructions and detailed floor plans have yet to be developed and so detailed Part L modelling has not been carried out.

In order to provide an indication of the Carbon Dioxide emissions which will arise from the development, a benchmark value has been utilised from a comparable sports centre project designed to equal sustainable new-construction standards.

High performance fabric and MEP systems will be proposed of an equivalent standard to all other buildings across the site. Equally, the building will connect into the Haringey District Heating network when available, to deliver further Carbon Dioxide emissions reductions. There will be no provision of renewable technology within this building.

At this outline stage, for the purposes of assessing the site wide Carbon Dioxide emissions results have been presented below. At this stage no improvements on the Lean stage of the hierarchy have been assumed, and a 10% improvement from the district heating connection has been assumed. All details will be explored further and confirmed whet the building applies for detailed planning approval.



Unit	TER	Lean	Clean	Green
$kgCO_2/m^2.yr$	*22.7*	*22.7*	*20.4*	*20.4*
tonnes CO_2/yr	*40*	*40*	*36*	*36*
%age reduction		*0%*	*10%*	*10%*

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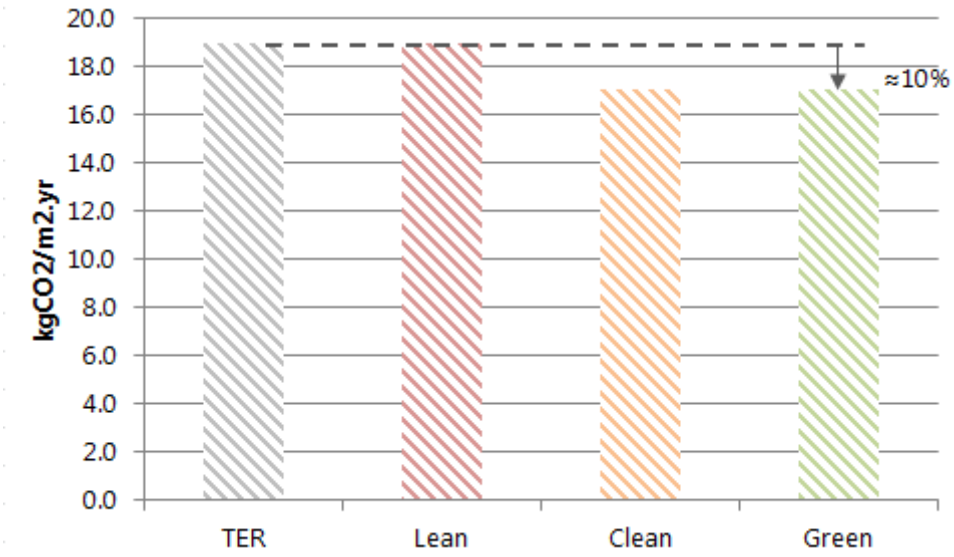
5.3 North-East building

The North-East building is envisaged to be a health centre serving the local community around the Northumberland Development project. At this outline stage façade constructions and detailed floor plans have yet to be developed and so detailed Part L modelling has not been carried out.

In order to provide an indication of the Carbon Dioxide emissions which will arise from the development, a benchmark value has been utilised from a comparable health centre development designed to equal sustainable new-construction standards.

High performance fabric and MEP systems will be proposed of an equivalent standard to all other buildings across the site. Equally, the building will connect into the Haringey District Heating network when available, to deliver further Carbon Dioxide emissions reductions. There will be no provision of renewable technology within this building.

At this outline stage, for the purposes of assessing the site wide Carbon Dioxide emissions results have been presented below. At this stage no improvements on the Lean stage of the hierarchy have been assumed, and a 10% improvement from the district heating connection has been assumed. All details will be explored further and confirmed whet the building applies for detailed planning approval.



Unit	TER	Lean	Clean	Green
$kgCO_2/m^2.yr$	*19.0*	*19.0*	*17.1*	*17.1*
tonnes CO_2/yr	*42*	*42*	*38*	*38*
%age reduction		*0%*	*10%*	*10%*

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6 Overheating

As stated within policy, all developments must make reasonable endeavours to mitigate overheating risks and ensure cooling demands are managed to prevent excessive energy consumption from air-conditioning systems.

Across the development this has been achieved through provision of passive solar control measures such as solar control glazing (low g-value), self-shading from building form and minimising the air-conditioned areas to essential spaces.

Part L Criterion 3 is an effective measure of overheating risk and excessive solar exposure. All spaces within buildings across the development which are occupied for large periods of the day are compliant with Criterion 3 as can be seen within the BRUKL documentation provided in the appendix. Spaces which do not comply, primarily include circulation areas such as concourses, which are not occupied for large portions of the day and are therefore exempt from the assessment as per Approved Documents Part L2A methodology.

The residential towers are not envisaged to be comfort cooled, and overheating risk will be effectively managed when the design progresses to a greater level of detail. The indicative apartment performed well from an overheating perspective due to the large openable windows area and self-shading provided by the balcony structure.

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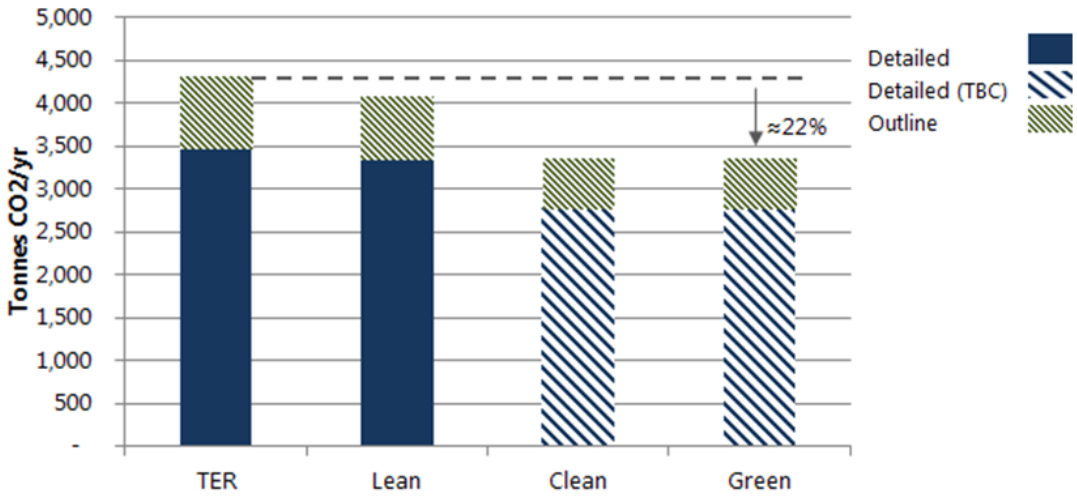
7 Summary

7.1 Overall results

The graph below summarises the results from all components of the Northumberland Development project. Differentiation has been provided between the detailed and outline elements of the application, in addition to the savings achieved through connection to the DEN to be delivered by the council.



tonnes CO_2/yr	TER	Lean	Clean	Green
Detailed	3,460	3,330	*2,780*	*2,780*
Outline	860	760	*600*	*575*
TOTAL	**4,320**	**4,100**	***3,370***	***3,350***
%age reduction		5%	*22%*	*22%*

As shown in the results above; based on proposals for the detailed elements of the application and the assumptions included within this report regarding the district heating and the outline elements of the application it is estimated that the Northumberland Development project could achieve a total site-wide Carbon Dioxide emissions reduction of 22% compared to a Part L 2013 gas-boiler TER baseline.

At this stage, the carbon efficiency of the Haringey District Heating network will have the largest impact on the results but this cannot be explored in greater detail until this technical information is available. Until this district heating connection becomes available the development has employed all viable sustainable design measures and can achieve a 5% Carbon Dioxide emissions reduction from those alone.

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James Davies
Buro Happold Limited
Camden Mill
Lower Bristol Road
Bath
BA2 3DQ
UK

T: +44 (0)1225 320 600
F: +44 (0)870 787 4148
Email: james.davies@burohappold.com